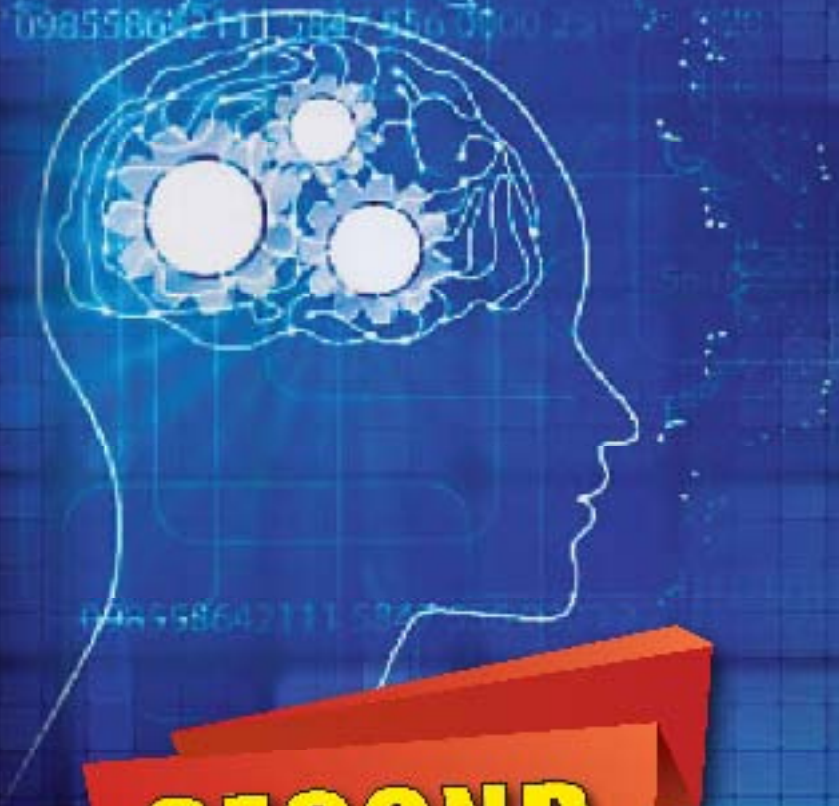
THE DOCTORAL RESEARCH ABSTRACTS

Volume: 2, Issue 2 Nov 2012



SECOND ISSUE

INSTITUTE of GRADUATE STUDIES

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Name : **Nor Rul Hasma Bt Abdullah**

Title : **Computational Intelligence Based Power System Security Assessment and Improvement under Multi-Contingencies Conditions**

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This thesis presents new techniques for voltage stability assessment and improvement in power system under multi-contingencies. A line-based voltage stability index termed as Static Voltage Stability Index (*SVSI*) was used to evaluate the voltage stability condition on a line. The value of *SVSI* was computed to identify the most sensitive line and corresponding weak bus in the system. The results obtained from the voltage stability analysis

using *SVSI* were utilized to identify most sensitive line corresponds to a load bus and estimate the maximum loadability and operating margin in the system. The *SVSI* was consequently used as the line outage severity indicator in the implementation of contingency analysis and ranking. The application of *SVSI* was extended for the evaluation of the constrained power planning (CPP) and Flexible AC Transmission Systems (FACTS) devices installation using Evolutionary Programming (EP) by considering multi-contingencies occurrence in the system. The minimizations of *SVSI* and transmission loss are used as two separate objective functions for the development of optimization technique. The effect of reactive power load variation on transmission loss in the system is also investigated. Consequently, the EP optimization technique is extended for the evaluation of the operating generator scheduling (OGS) to be applied on reactive power control in power system. The results obtained from the study can be used by the power system operators to make a decision either to achieve minimal *SVSI*, minimal transmission loss or minimal installation cost. This has also avoided all generators to dispatch power at the same time. Finally, a novel multi-objective Constrained Reactive Power Control (CRPC) algorithm using the state-of-the-art of EP for voltage stability improvement has been developed. A performance comparison with Artificial Immune System (AIS) in terms of *SVSI* and loss minimization was made and it is found that the proposed algorithm has been able to produce better results as compared to AIS. The contributions of the studies among the others are the development EP and AIS engine for CPP considered multi-contingencies *(N-m)*, the development of EP and AIS engine for FACTS installation considered multi-contingencies *(N-m)* for the determination of FACTS placement using *SVSI* and optimal sizing of FACTS using EP and AIS, the development of new technique for OGS based on EP optimization technique and the development of multi-objective EP and AIS engines for CRPC considered multi-contingencies *(N-m).*